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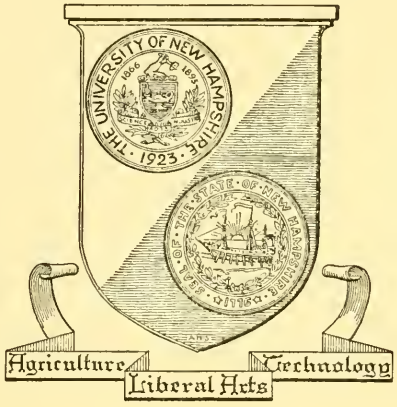

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LEGUME AND GRASS SILAGE

A Survey of Methods and Results on 380 Northeastern Farms

NEW HAMPSHIRE AGRICULTURAL EXPERIMENT STATION
University of New Hampshire
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FOREWORD

This survey was suggested by H. W. Jeffers, Sr., president of the New Jersey State Board of Regents. A committee to make the survey was appointed by J. W. Bartlett of New Jersey, at a feed conference at Baltimore, Maryland, in November 1937, where most of the states of the Atlantic Seaboard were represented.

The survey was made and the bulletin prepared under the direction of the following committee:

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In addition, the committee expresses its thanks to the county agents, cow-testers, and 380 operators who answered the questionnaires.

Legume and Grass Silage

History and Purposes

Problems relative to the curing of legumes and grasses as high quality roughage have always been of paramount importance to dairymen. In order to prevent loss in preserving these roughages, research work was instituted to find ways of solving the problem. Preserving the material as a silage seemed to hold the greatest promise. From the studies made on the normal ensiling process of the corn plant it was concluded that the reasons for common failure in preserving legumes and grasses as high quality silage was due to the low sugar and high protein contents of these plants, which prevented desirable fermentation. Low sugar content prevents quick fermentation and permits undesirable bacterial action to start. Such action decomposes the proteins, producing strong smelling and in many cases, putrid silage. Cows would eat this material in some cases and in others the rotted mass had to be removed from the silos and spread on the fields.

The addition of molasses to the legumes and grasses as they were being ensiled overcame the difficulty. The sugar in the molasses provided the nutrients necessary for bacterial action, which produced the desirable acidity for preservation. The lactic and acetic acid formed (the same acids produced in ensiling corn) preserved the legumes and grasses with very slight nutrient losses.

Commercial phosphoric acid has been used in both controlled experiments and on farms, to directly increase the acidity of the ensiled material. This reduces bacterial action immediately. The method shows some promise but is newer and has less practical experience behind it.

Ordinarily it takes ten years for a new method to be adopted by the farming public after all the experimental work has been completed. In this particular case, before all the ramifications of the method, such as field operation, mechanical difficulties in chopping, and silo filling, had been overcome, many dairymen tried it out.

It was believed by the committee that if this survey covered a fair percentage of farms whose operators ensiled legumes and grasses, factual in-

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formation of great value could be gathered. Ten states actively cooperated in the survey. In addition, returns were received from operators in seven other states. The returns from 380 operators located in seventeen states form the basis of this publication.

Nine returns were received from Maine, 12 from New Hampshire; 17, Vermont; 29, Massachusetts; 10, Connecticut; 149, New York; 60, New Jersey; 64, Pennsylvania; 17, Maryland; 2, Virginia; 1, West Virginia; 1, Indiana; 1, Florida; 1, Wisconsin; 1, Michigan; 3, Ohio; 3, Illinois.

The value of this method of ensiling crops may be considered from several points of view, namely, crop insurance, erosion control, and pasture management.

Crop Insurance

During poor haying weather any crop may be ensiled with the knowledge that it will be preserved with a small fraction of the loss common to hay making.

Erosion Control

On farms where erosion is a serious factor, legumes and grasses may be planted instead of corn. Silage made from these plants will replace corn silage in the ration of dairy cattle and other animals, as shown not only by experimental work, but also by this survey. Furthermore, with good fertilization practices, it is possible to get tonnages of these grasses and legumes equivalent to corn and at the same time produce a silage with a higher protein content.

Pasture Management

With this system of preserving grasses and legumes it is possible to efficiently manage permanent pastures fertilized for maximum production. The practice of ensiling excess production of pasture grasses fits into the pasture fertilization and management scheme that is now meeting with so much favor in the northeastern states. Surplus pasture grasses preserved in this manner will go a long way in keeping up the milk flow in the hot summer period when pastures are short. It affords a means of preserving surplus pasture of high feeding value, which otherwise might be lost. The practice helps to a considerable extent in reducing the cost of producing milk and replacement animals essential for the dairy enterprise.

Crops

This survey shows that a wide range of crops and combinations of crops were used in making grass silage. They include practically all the legumes, cereals, and grasses grown in the northeastern part of the United States. The majority of the operators got very good results from these various materials, indicating that most crops put up properly will make good grass silage.

Alfalfa and combinations of alfalfa with wheat, oats, clover, and timothy, were used more extensively and over a wider area than any other crops. Clover, timothy, clover and timothy, timothy and grasses yielded a very good tonnage for a large number of operators on New England, New York, and New Jersey farms. Soybeans alone and in combination with other crops ranked high, both in green tonnage per acre and in popularity with the operators. Cowpeas, vetch, and sudan grass, in various combinations found their way into many silos.

Among the cereals used for grass silage, oats alone and in combination comprised a large acreage scattered through all the states of the northeastern section. Such combinations as oats and peas; oats and alfalfa; oats and clover; oats, millet and soybeans; and oats, peas and vetch, furnished a very palatable roughage on many farms. Other cereals ensiled were wheat, rye, barley, and Japanese millet.

Some operators ensiled combinations of winter wheat and vetch; rye and vetch; corn, millet and sudan grass; and pea and bean vines from the canneries. From New York comes a report of bluegrass making a satisfactory silage and the Florida Experiment Station reported Dallis grass yielding thirty tons an acre.

Alfalfa probably makes the best silage, as this survey demonstrates. This is because of the longer range of time over which the crop can be cut and ensiled and still make excellent silage. The operators have ensiled their alfalfa in all stages of growing conditions from pre-bloom, through half-bloom, full-bloom and after-bloom stages, and have reported their silage feeding out in very satisfactory condition. Furthermore, these methods provide a means of handling the first cutting of alfalfa which is usually difficult to cure and makes a coarse hay.

It should be noted, however, that crops cut in the after-bloom and mature stages did not keep as well in the silo unless large amounts of water were added. In any case the feeding value was materially lowered because the protein composition of the green materials decreased rapidly with maturity.

According to the survey, 16,610 milking cows were fed grass silage in amounts ranging from 12 to 95 pounds per cow per day. The amounts of silage fed depended on the breed of cows and the purpose for which it was intended, namely; to replace hay, corn silage, pasture, part, or all of the roughage in the diet. The highest amount of grass silage fed per head per day was 95 pounds. In this herd a mixed grass and legume silage was fed to replace all of the corn silage and most of the hay. The grain ratio fed in addition was one pound to four and one-half pounds of milk.

In feeding grass silage it should be kept in mind that alfalfa silage fed to replace corn silage delivers twice the amount of protein. A 1,000 pound cow producing 40 pounds of 3.5 per cent milk needs 2.5 pounds of *digestible protein*. The same cow fed 60 pounds of alfalfa silage a day will receive 2.7 pounds of *crude protein* which is almost enough to meet all

of her protein needs. In this case it would be advisable to reduce the protein content of the grain ration. A substantial number of operators in this survey took advantage of this fact. Many operators, however, fed grain more liberally than was necessary when a large amount of a legume silage was fed.

Three hundred and thirty-two of the operators reported that the cows ate the grass silage readily. Twenty-six reported difficulty. In practically every case the difficulties arose because the silage was either quite putrid, because of insufficient preservative, or because the material was too dry and of poor quality.

Eighty-three per cent of the operators reported grass silage was equal or superior to corn silage. Ninety-five per cent reported that it was equal or superior to hay. Again the quality of the crop was apparently the determining factor.

Thirty-nine per cent of the operators reported that grass silage improved milk color. This was influenced by the amount of silage fed and substantiates two years of experimental evidence collected at the New Jersey Experiment Station.

In addition to milking cows 3,595 heifers were fed grass silage in amounts ranging from 11 to 60 pounds a day. One hundred and thirty-six beef cattle were fed an average of 42 pounds a day. Forty-two horses received an average of 28 pounds daily. Six hundred sheep averaged 3 pounds a day. Four thousand two hundred eighty head of poultry were fed grass silage at the rate of 4 pounds per hundred birds with excellent results, and ten brood sows received their daily quota.

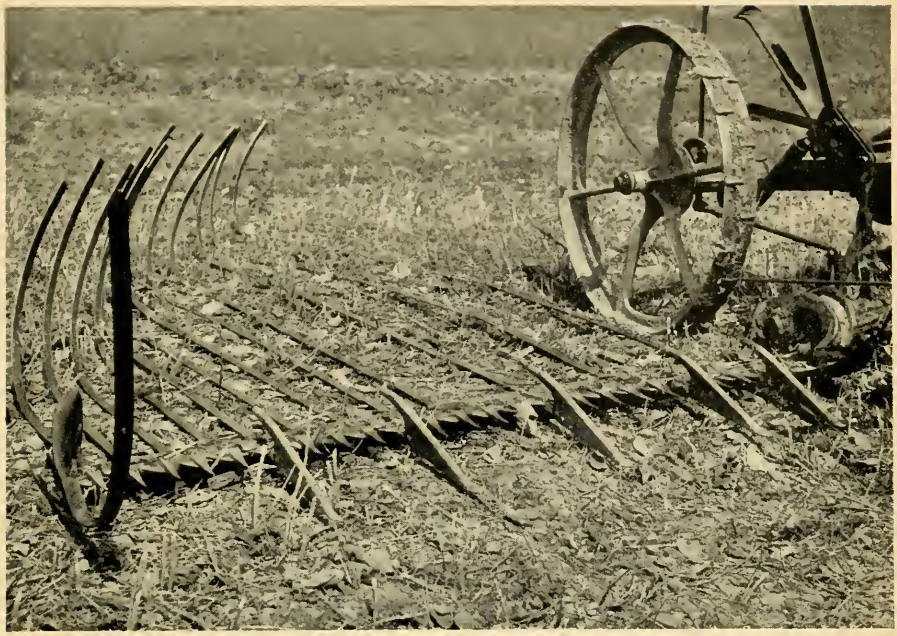
Harvesting and Storing Methods

Mowing

The survey indicates that care should be taken not to cut down more hay than can be put away in the same half day. After cutting, the sooner the crop goes into the silo, the better. In good haying weather, not over two hours should elapse between mowing and ensiling. In cloudy or rainy weather, a somewhat longer interval may be permissible. Any of the crop that lies in the field long enough to become partly dry can be cured as hay or can be made into silage by adding enough water at the silo to replace the lost moisture.

Raking

A windrower, costing from $10 to $20, attached to any horse-drawn or tractor mower did the work of a rake, without the extra operation, especially where the windrower did not have to be rolled up sharp slopes. In



Windrow Attachment on Cutter Bar Eliminates One Field Operation

such cases, raking or swath loading was necessary. When a windrower could be used, stones were not so apt to be picked up as in side-delivery raked windrows. To avoid stones when a side-delivery rake is used, the reel should be given as much ground clearance as clean raking permits. If a tractor mower is used, the side-delivery rake may be trailed behind the mower to save a separate raking operation.

Loading

Modern cylinder-rake bar loaders pick up most crops directly from the swath. Well-built cylinder-rope loaders in good condition will handle one-swath windrows fairly well if the crop is not too heavy. For trouble-free operation, all cylinder-rope loaders should be rebuilt as follows: Replace original slats with heavy oak. Replace ropes with No. 3 welded machine link chain.

In buying a new loader, care should be taken to select one that is specifically designed for green hay. A number of these loaders are now on the market. They handle dry hay as well as green hay and cost only about $20 more than standard dry hay loaders.

If clean loading cannot be secured from the swath or behind a wind-

rower, the leavings may be thrown onto the next swath by following the loader with a side-delivery rake.

Building the Load

Because green hay weighs about 3 times as much as dry hay, fair sized loads can be built without the care required in loading dry hay. A number of experienced operators used short square-shaped racks or dump truck bodies and allowed the green hay to fall as it would from the loader. A 2,000 or 3,000 pound load of green hay can be put on with no one working on the load. When a wagon is used, the driver may have to stop once or twice to pull the peak of the pile forward on the load. In truck loading, the driver can often throw the peak forward by making a quick stop.

Unloading

Considerable time and labor can usually be saved by dumping loads at the silo. Dump bodies may be inexpensively built for trucks, trailers or wagons. V-ropes, slings or other devices may be used to roll or slide the loads from wagons or trucks. With the silo filler set in a trench or with its truck wheels set in the ground to the axles, the labor of feeding the machine is less arduous. Pitching, with both feet on the solid ground is easier than from the top of a load and any stones in the load are more apt to be ob-

One-Man Operation in Loading and Hauling

served. With this arrangement, two men can pitch a ton of green hay to a silo filler in 10 minutes or less.

Silo Filler

Almost any flywheel-type cutter in reasonably good condition will cut and elevate green hay crops. Machines with throats 14 inches wide or larger do the work faster and at lower power cost per ton cut, than smaller machines. Modern machines, with feed rolls designed for handling hay crops, are easier to feed than standard ensilage cutters. The silo filler should be set for ¼ to ½ inch cut. Silage cut on longer settings does not pack as well in the silo. Shorter settings slow up the work.

Adding Molasses as a Preservative

The experience of most operators indicates that the following quantities of molasses, should be added to each estimated ton of green material for the best preservation:

Kind of Crop	*Molasses per Ton*
Grasses or Cereals	40 lbs. (3½ gals.)
Mixed grasses and Legumes	60 lbs. (5 gals.)
Alfalfa or Clovers	80 lbs. (7 gals.)
Soybeans	100 lbs. (8½ gals.)

It is not necessary to apply the exact amount of molasses called for by the above table. Some operators used more molasses than was needed for preservation, and in so doing, not only made a more palatable silage but added feeding value at low cost.

The molasses may be added by gravity, air pressure or pump. The most simple method calls for a drum, two valves and a short piece of hose or pipe leading to the blower. The line should be one-inch in size or larger. If the line is over 6 feet long the larger sizes will be necessary. Enough molasses to treat each load is poured into the drum. A pail or two of water may be added, if necessary, to speed up the flow when the molasses is cool. One valve is used to open the line *after* feeding starts. It should be always closed *before* feeding stops. The other valve is set so that the proper amount of preservative is applied to the load.

The molasses should be delivered to the blower at a point inside the path of the fans so that the blower will suck on the molasses line rather than blow against it.

If any considerable amount of molasses runs into the blower when no forage is going through, pipe clogging results. An automatic molasses shut-off has been made by setting one valve at the lower end of the line where it goes into the blower and connecting it by a rod to the upper feed roll of the silo filler. When the feed roll is raised by the forage, the line automatically opens. As the rate of feeding increases, the feed roll rises higher

and the valve opens wider. When no forage is going in, the feed roll falls and closes the molasses line.

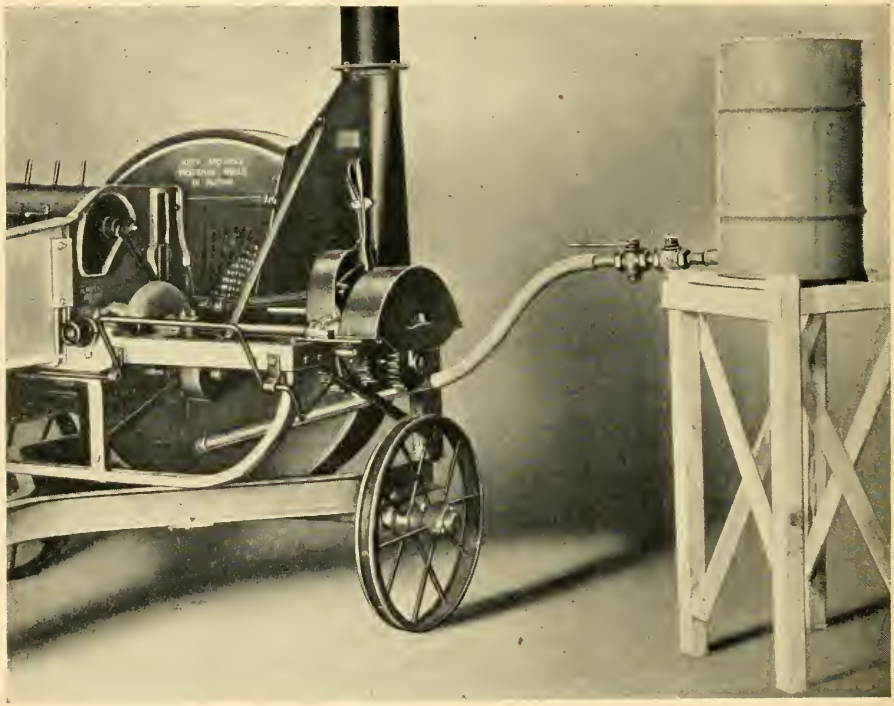
When undiluted molasses was run onto the feed table, a number of operators found that it tended to build up on apron chain, sprockets and feed rolls to such an extent that breakage resulted. A few operators used pumps or air pressure on drums to deliver molasses to their silo fillers.

Silo

Good silage was made in all kinds and types of upright silos as long as they were in reasonably good condition and had tight-fitting doors. Silos with open drains or gravel bottoms seemed to produce the most uniform silage. A number of temporary silos, made of snow fence lined with reenforced moisture-proof paper, were used with fairly satisfactory results, although spoilage was extensive in some cases.

Storing

The reports indicate that silage should be well tramped, especially the outside edges and the top third of each filling. Molasses silage may be



Method of Adding Molasses to Green Material

stored in the same silo with corn silage, either above or below. There is apparently no need to fill continuously. Surface spoilage will usually not start for two or more days. Spoilage, however, may be serious when several lots are put in at widely spaced intervals without sealing.

Sealing the Silo

When the silage was not to be fed within a few days after filling, surface spoilage was materially reduced in many cases by sealing the silo with a foot or more of wet sawdust, weeds, straw or other waste materials. A layer of tar paper between the silage and the sealing material reduced spoilage to practically nothing in several instances. A number of operators held surface spoilage to a few inches without special sealing, by leveling and tramping the top very thoroughly and then sprinkling the surface for a few hours with water.

Adding Phosphoric Acid as a Preservative

Thirty-four operators among the total of 380 who took part in the survey used commercial phosphoric acid as the preservative. Two of these operators decided that in the future they would change to the molasses method. All the others appeared to be satisfied.

Commercial phosphoric acid is not corrosive in the sense that other acids are corrosive. It will not injure the person or the clothing and is easy to use. It cannot, however, be handled in steel drums because it attacks metal to some extent, but does not injure the silage cutter or blower as it passes through it. The machine, however, should be washed off after use. Phosphoric acid has not yet been distributed successfully in wooden barrels. These difficulties add to the cost of handling and therefore the final cost.

Method of Use

Phosphoric acid may be used with all legume and grass crops that are suitable for the same type of silage as preserved with molasses. The action, however, is direct in bringing about the desired acidity of the silage. The fermentation is less and therefore less heat is produced. Consequently from a theoretical point of view, less energy and therefore food value, is lost by this method of preservation.

The field operations are the same as for molasses silage in getting the crop to the cutter and have been fully discussed.

Amount of Acid to Use

To prevent bacterial action, the maximum amount of acid necessary to preserve legume crops, as represented by alfalfa or soybeans, seems to be 16 pounds (1¼ gallons) to one ton of green material. No one of

the thirty-four operators suggested more than this amount per ton, and in all cases of severe spoilage, the trouble could be traced back to the use of a lesser amount.

Most operators apply the acid directly to the green material as it passes over the feeding table. This method is the simplest but the application of 16 pounds of phosphoric acid to 2,000 pounds of green material requires very great care to see that the acid is properly distributed. A better method is to dilute the acid with four or five times its weight of water and run it into the blower drum as is suggested with molasses. All silo fillers may be fitted for a pipe to receive the diluted phosphoric acid at the proper point in the blower drum.

It would seem reasonable to suggest that less acid would be necessary to preserve non-legume material or mixed grasses and legumes, but the results of the survey do not prove this and the results of experiments are not available as yet so far as we know. The difference in cost in using a lesser amount, however, is small, and while it amounts to a tidy sum on a full silo, the risk of spoilage is great if too little acid is used. Therefore, the definite advice is to use 16 pounds of acid to the ton of green material until further work shows that the amount may be successfully reduced for any particular crop or mixture of crops.

Adding Water to Green Material

The best quality of silage is made when the crop is cut at the bloom or just before bloom stage for the grasses, alfalfa, and clover; and when the pods are well filled on the soybean plant and before any leaves are lost. Then the crops are put into the silo without wilting and with no water added. Crops cut at these ideal stages and ensiled at once need no additional water except that added at the top when sealing the silo. The moisture in the ensiled material should be 70 per cent. If there is reason to believe that this amount of moisture is not present, then water must be added.

The methods of tramping, sealing the silo, treatment of silo, and general use of harvesting and filling machinery have all been covered in the molasses silage section and need not be repeated here.

Feeding Silage made with Phosphoric Acid

When properly made, silage preserved with phosphoric acid is as valuable for all classes of livestock as any other silage. Most operators rated it equal or superior to hay or corn silage. It can be used to replace all the corn silage usually found in the ration and a part of the hay. It is desirable to feed some dry hay with the acid silage, however. The results of the survey show that it may be and is being used for dairy cattle, beef cattle, young and dry stock, horses, sheep, and swine and to some extent for

poultry. One operator feeds it to all classes of animals and is very enthusiastic as to its value. Some long-time experiments are needed, however, before the phosphoric acid method of preserving silage can be recommended as unreservedly as the molasses method.

The results of this survey do not indicate that phosphoric acid is a more expensive preservative than molasses. It is certainly easier to handle. When properly used there is no more spoilage and the silage seems as palatable to cattle and gives as good production results. However, there are some possible adverse points that should be mentioned. The danger from fluorine contamination is not fully cleared yet. Expert opinion in general says there is no danger. However, it is desirable that long-time continuous feeding trials be made on phosphoric acid silage.

The effect of a high level of phosphorous feeding over a long period may produce results that are not now known.

Therefore, farmers thinking about adopting this method of preserving silage made from legumes and grasses with phosphoric acid must adopt the method with their eyes open and with the full knowledge that the method is new and needs study.

Conclusion

From the 380 operators reporting on this questionnaire, 75 per cent said they would put up grass or legume silage for regular winter feeding, either to replace corn silage, hay, or part of both. Sixty-eight per cent planned to use it to supplement pasture. Only six per cent of the operators said that they did not plan to put up grass or legume silage in the future.

SUMMARY OF GRASS AND LEGUME SILAGE SURVEY

Operations

Method of Preservation

The following number of operators report using the various methods of preservation:

Molasses	328	A. I. V.	3
Phosphoric Acid	34	No Preservative	15

Preservative used per ton of green material

Where molasses grass silage was preserved the rate of application varied from 14 pounds to 250 pounds per ton. The weighted average for the various types of materials ranged from 45 to 75 pounds as is shown in the following table:

Operators Reporting Molasses Applied on Some of the Green Crops

Type of Material	Cases	Molasses applied per ton Range	Weighted Average
		pounds	*pounds*
100% Alfalfa	29	50 to 100	75
75% Alfalfa	9	45 to 75	60
50% Alfalfa	18	14 to 70	50
25% Alfalfa	4	55 to 80	70
Clover	7	50 to 80	70
Clover and Timothy	17	25 to 250	60
Cereals	25	26 to 60	48
Oats and Peas	6	50 to 70	60
Soybeans	6	40 to 70	60
Soybeans and Sudan	7	50 to 70	60
Timothy and Grass	20	30 to 60	45

The range in price paid for this molasses was .8¢ to 3.0¢ per pound with an average price of 1.2¢. Several of the operators realized that the lower amounts of molasses applied were not sufficient for proper preservation. Fifty-three of them advised the use of plenty of preservative.

The 34 operators reporting phosphoric acid silage used from 3½ to 20 pounds of phosphoric acid per ton. The average cost of this acid was 5½¢ per pound.

Was the preservative diluted with water?

One hundred sixty operators using molasses reported that it was diluted with water, while 164 reported no dilution. Sixteen operators using phosphoric acid diluted it with water while 13 reported no dilution.

How much water was added per ton of green material?

The rate of dilution in both molasses and phosphoric acid silage showed that dilutions were made up to 60 gallons of water per ton of green material in each group. Twenty-three advised the addition of water to material that

is too dry, thus showing that they realized the danger of insufficient water in the material being ensiled.

How was preservative added?

The majority of operators used the gravity system for adding preservative. Of those using molasses 237 reported having used the gravity method; 29 used the air-pressure method; while 15 applied molasses by sprinkler and 3 by pump. Thirty-one of the 34 phosphoric acid operators applied their preservative by gravity while 3 applied the acid by sprinkler in the silo.

Method of preservation preferred.

Very few operators reported any preference as to methods of preservation of silage, since few of them have used more than one method.

Kind of Crop Ensiled

The table shown on page 16 gives the number of operators using the various types of materials for molasses silage. Those reporting phosphoric acid silage show that 13 used 75% alfalfa; 9 used 50% alfalfa; 6 used mixed grasses; and 3 used non-legumes.

Estimated Yields

The yields on some of the crops reported show that the average tonnage of green weight per acre was as follows:

Crop	*Single Cutting*	*Tons per acre*
100% Alfalfa	" "	7.8
75% Alfalfa	" "	8.7
50% Alfalfa	" "	5.9
25% Alfalfa	" "	6.0
Clover	" "	9.0
Clover and Timothy	" "	7.2
Cereals		8.1
Oats and Peas		9.0
Soybeans		9.0
Soybean and Sudan		9.0
Timothy and Grass	" "	7.9

Stage of Maturity at Cutting

Forty-seven operators reported cutting their various grasses and legumes in the pre-bloom stage; 109 cut their materials in the half-bloom stage; 129 in the full-bloom stage; and 35 after the bloom stage.

Sixty-two operators made the suggestion that grasses and legumes be cut early, thus showing that they realized the superior feeding value of crops cut at this stage.

How Much of the Material was Put Into the Silo Green, Slightly Wilted or Well Wilted?

Two hundred forty-three operators reported ensiling crops green, while 67 reported storing their crops in the slightly wilted stage. Seven reported storing their crops in the well wilted stage. It is interesting to note that the greatest number of recommendations to farmers putting up grass silage were made by operators on this question. Ninety-eight of these operators stressed the value of high moisture in the material being ensiled.

Was Material Picked up From Swath or Windrow?

One hundred forty-one operators report picking up the material from the swath, and 198 from the windrow. Seven used binders and two bunched the material.

Was Hay Loader Used?

One hundred fifty-nine used hay loaders and 152 did not.

Loader Troubles

Breakage was generally reported for all cylinder-rope loaders especially of ropes and slats. Cylinder rake-bar loaders constructed for green material were generally satisfactory. Twenty-four operators pointed out the necessity for equipment specially constructed for handling green crops.

Method of Hauling

Two hundred twenty-nine operators hauled their green material by wagon and 136 used trucks. Eighteen reported using both wagons and trucks.

Kind of Cutter

Fourteen makes of cutters were reported.

Length of Cut

Seventy-nine reported setting the cutters for ¼″ cut; 143 for ½″ cut; 43 for ¾″ cut; and 47 for over ¾″ cut.

Cutter or Blower Troubles

One hundred eighty-two reported having had no trouble with their cutters or blowers; whereas 137 reported troubles, many of which were easily corrected.

Method of Tramping

Two hundred twenty-two operators reported that they used only one man in the silo for tramping and distributing. Sixty-four used 2 men, while 8 used 3 men. Fifty-three operators reported no men in the silo except for leveling.

Sealing the Silo

One hundred seventeen operators reported that no special seal was used, whereas 102 reported that they used some method of sealing their silos. Twenty-three reported additional tramping as a seal.

Size of Silo

Silos reported ranged in diameter from 8 to 30 feet, and in height from 8 to 90 feet.

Kind of Silo

Two hundred two operators reported having wood silos. Other types of silos and the number of cooperators reporting are as follows: Wood, 202; Tile, 60; Concrete Stave, 55; Metal, 8; Snow Fence, 5; Solid Concrete, 4; Lath and Plaster, 1; Stored in stacks, 2; Barrels *1. Most of these silos were reported to be in good or excellent shape, whereas a few were reported to be fair or poor. Silos in poor condition had greater spoilage.

Depth of Settled Silage

The depth of settled silage reported varied from 6 feet to 70 feet.

Amount of Material Preserved

The operators reporting the amount of silage preserved, reported a total of 50,186 tons.

Intervals Between Fillings

Two hundred nine operators reported that their silos were filled as a continuous operation; whereas 116 stated that they filled their silos intermittently. The interval between fillings varied from 1 day to 90 days.

Type of Silo Bottom

One hundred seventy operators reported that their silos had solid bottoms without drains, and 60 reported solid bottoms with drains. One hundred two reported gravel bottoms without drains, whereas 17 reported gravel bottoms with drains.

Seepage from Silo

One hundred twenty-eight operators reported considerable seepage from the silo; 216 reported no seepage and 15 reported slight seepage.

Heating as Compared with Corn Silage

One hundred thirty-five operators reported that there was more heating than with corn silage, and 131 reported that there was no more heating than with corn silage. Nine reported less heating and 3 reported that the heating was the same for both grass and corn silage.

Length of Time from Filling to Feeding

Forty operators reported that they started feeding immediately after filling. The longest interval between filling and feeding was 7 months.

Depth of Spoilage

Ninety-four reported less than 1 foot of spoilage on the top of the silo, whereas 121 reported over 1 foot of spoilage.

Moldy Spots

Eighty-eight operators reported that there were no moldy spots; 187 reported a few moldy spots. Forty-two reported many.

Spoilage Along Silo Wall

One hundred fifty-two operators reported that they had no spoilage along the silo wall. One hundred and two reported a small amount and 56

*This operator preserved soybeans in barrels using molasses as the preservative for winter feeding for poultry.

reported extensive spoilage. One operator reported spoilage only at the doors, while others reported spoilage around the entire circumference of the silo and to varying depths. Apparently, some of these operators recognized the fact that their difficulties were due to the condition of the silos, as 16 of them included this in their recommendations. Others apparently realized that their spoilage was coming from insufficient packing, since 64 of them recommended thorough tramping.

Condition of Silage

Various colors are reported for the silage. Ninety-two operators reported green silage, and 217 brown silage. Eleven had black material. Ten reported that their silage was dry, while 247 reported that their silage was moist, and 13 that their silage was wet.

Years of Experience with Legume and Grass Silage:

1 year	255
2 years	52
3 "	17
4 "	4
5 "	4
7 "	1
8 "	1
15 "	3
17 "	1
20 "	1

Feeding Methods

Livestock and Quantities of Silage Fed

Three thousand, eight hundred and thirty-four Holstein cows were fed grass silage in amounts ranging from 12 to 60 pounds with an average of 38 pounds; 2,683 Guernseys from 15 to 60 pounds with an average of 27 pounds; 893 Jerseys 13 to 75 pounds with an average of 35 pounds; 483 Ayrshires 18 to 70 pounds with an average of 20 pounds; 146 Brown Swiss from 20 to 95 pounds with an average of 43 pounds. Forty-five head of Shorthorns received from 12 to 30 pounds with an average of 20 pounds. Seven thousand, five hundred and twenty-six dairy animals of mixed breeding received from 14 to 90 pounds with an average of 29 pounds daily. Three thousand, five hundred and ninety-five head of young dairy stock received from 11 to 60 pounds with an average of 18 pounds daily. One hundred and thirty-six beef cattle received from 20 to 80 pounds with an average of 42 pounds. Forty-two horses were fed grass silage ranging in quantity from 9 to 60 pounds with an average of 28. Six hundred sheep were fed grass silage ranging from 1 to 12 pounds with an average of 3 pounds per head daily. Four thousand, two hundred and eighty head of poultry received 4 pounds per 100 birds daily. Grass silage was reported as being fed to 10 head of swine.

Was Corn Silage Fed? If so, How Much?

Two hundred and ten operators fed no corn silage while grass silage was being fed; 108 operators fed both grass silage and corn silage to their dairy animals. The corn silage was fed in quantities from 10 to 60 pounds with an average of 30 pounds.

Was Hay Also Fed?

Two hundred and forty-two operators fed hay with grass silage. The hay ranged from 2 to 18 pounds with an average of 12 pounds. Seventy-eight operators did not feed hay with grass silage.

Was Silage Fed Before, During, or After Milking?

One hundred nine operators fed grass silage before milking, while 38 fed during milking. One hundred and sixty-two fed after milking.

Rate of Grain Fed

Grain was fed to dairy cows at an average rate of 1 pound of grain to 4 pounds of milk. The range of feeding was from 1 pound of grain to 2 pounds of milk down to 1 pound of grain to 7 pounds of milk.

Protein Percentage of Grain Ration

Grain rations varied from 12 per cent to 24 per cent protein. The average of all grain rations fed was 20 per cent protein.

Was the Silage Readily Eaten by the Cow?

Three hundred and thirty-two operators reported that the silage was readily eaten by the cows, while 26 reported the silage as somewhat unpalatable.

Was Protein Percentage of Grain Reduced While Feeding Silage?

Two hundred and seventy-six operators reported that the protein percentage of the grain ration was not reduced, while 37 reduced the protein content while feeding grass silage.

Was Amount of Grain Fed Daily Per Cow Reduced?

Two hundred and thirty-one operators did not reduce the amount of grain fed while feeding grass silage. Fifty-seven reduced the amount of grain at this time.

Is Silage Inferior, Equal, or Superior to Corn Silage for Milk Production?

One hundred and sixteen operators reported grass silage superior to corn silage for milk production, while 154 felt it was equal and 57 reported grass silage was inferior to corn silage for milk production.

Is Silage Inferior, Equal, or Superior to Dry Hay for Milk Production?

Two hundred fourteen operators reported grass silage superior, while 63 reported it equal and 13 as inferior to dry hay for milk production.

Did the Cows Gain, Maintain, or lose Weight on the Silage?

Two hundred and twenty-four operators reported that their cows maintained their body weight on grass silage; 65 reported gains; and 12 reported losses.

Apparent Health and Breeding Condition

Three hundred and seventeen operators reported the health and breeding condition of their herds was good or excellent and 3 reported the condition as poor when fed grass silage.

Was Silage Fed to Supplement Summer Pasture?

One hundred seventy-seven operators did not feed silage to supplement summer pasture, while 151 fed it for this purpose.

Was Grain Fed?

Answers were so incomplete as to the grain fed while silage supplemented pasture that no report can be made in this regard.

Was Milk Production Maintained While the Silage was Fed to Cows on Pasture?

Ninety-three operators reported that milk production was maintained while silage was fed to cows on pasture, whereas only 1 operator said that milk production was not maintained at this time.

Labor

Size of Crew

The size of crew used varied from 2 to 14 men. The length of time in which the crop was harvested each day varied from 1½ to 12 hours. The range in silage harvested was from 1 to 125 tons per day.

How Were Men Used?

No summary on this question can be made. In some cases operation of the mowing, loading, hauling, chopping, and filling was continuous. In other cases a single load was harvested and chopped by the same crew.

Are as Many or More Men Needed Than When Filling Silo with Corn?

One hundred and twenty-two operators reported that the same number of men were necessary for harvesting grass silage as for harvesting corn silage. One hundred eleven reported fewer men necessary; and 46 reported more men were necessary for harvesting grass silage.

Is Work Harder or Easier?

One hundred and fifty-four operators reported the harvesting of grass silage easier than harvesting corn silage. One hundred and nineteen operators reported the work was harder and 60 reported the work equal.

How Can Laber Be Reduced?

Various suggestions were made as to methods of reducing labor. Most of these referred to the use of equipment. The greatest apparent need is for better loaders and faster hauling equipment.

Milk

Does Silage Make the Color of Milk More Yellow?

Ninety operators reported that the color of the milk produced was more yellow while feeding grass silage. One hundred forty-three reported no change in color.

Is the Flavor of the Milk Improved, Unchanged, or Injured?

Two hundred thirty-eight operators stated that the flavor of the milk produced was unchanged when feeding grass silage, while 25 reported an improvement and 6 reported injury to the flavor.

Costs

No accurate figures concerning costs can be summarized. Careful consideration of the survey has lead to the conclusion that grass and legume silage is no more expensive to harvest and store than corn silage. In this connection it should be noted that plowing and cultivating expense is materially reduced with grasses and legumes. Furthermore, the hazards of weather and the resulting costs and losses, especially in making first cutting alfalfa hay are largely eliminated.

Further Information

Do You Plan to Make This Kind of Silage to Feed Regularly in Winter?

Two hundred and twenty-seven operators definitely plan to make grass silage for winter feeding, while 74 do not plan to use grass silage for feeding at this season.

Do You Plan to Use This Kind of Silage to Supplement Summer Pasture in the Future?

One hundred ninety-three operators plan to use grass silage to supplement summer pasture in the future, while 91 do not plan to use grass silage for this purpose.

Will You Put up This Kind of Silage Regardless of Weather Conditions at Haying Time or Only When the Weather Does Not Permit Making Good Hay?

Two hundred twenty-four operators plan to make grass silage regardless of weather conditions at haying time. Fifty-two plan to make grass silage when weather does not permit making good hay, while 18 do not intend to continue making grass silage.

What Advice Would You Give a Man who is Planning to Make and Feed This Kind of Silage for the First Time?

Ninety-eight advised the use of materials with a high moisture content. Sixty-four suggested that the material be thoroughly tramped in the silo. Sixty-two advised that materials be cut early; 53 stated that plenty of preservative should be used; 31 suggested information be obtained from others who have made grass silage. Twenty-four stressed the importance of good equipment; 23 stated that water should be added to the material that is too dry; 16 felt that tight silos are very essential; 15 recommended the use of some method of sealing; 12 gave the warning to go slow; 4 advised cutting material fine; and 4 advised feeding lightly at first.

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